Vol. 71, No. 4 Established 1884 April 1954

ARCHIVES OF PEDIATRICS

A MONTHLY DEVOTED TO THE

DISEASES OF INFANTS AND CHILDREN

JOHN FITCH LANDON, M.D., Editor

LEADING ARTICLES IN THIS NUMBER

E. B. TREAT & CO., Inc., *Publishers,* 45 East 17th Street, NEW YORK, 3
Yearly Subscription $6.00 (Foreign $6.75); Single Copy, $1.00

Entered as second-class matter Feb. 5, 1892, at New York, N. Y., P. O., under the Act of March 3, 1879

IS HUMAN POLIOMYELITIS CAUSED BY AN EXOGENOUS VIRUS?

RALPH R. SCOBEY, M.D.
Syracuse, N.Y.

It is now nearly half a century since Landsteiner[1, 2] and Flexner and Lewis[3] established the basis for the virus theory of the cause of poliomyelitis. Since that time the virus has been isolated, purified, classified into strains, photographed, cultured, and vaccines prepared with it in the experimental laboratory. However, human poliomyelitis remains still an enigma and many things concerning it cannot be explained by the exogenous virus theory. Landon[4] stated, in 1938, that experimental evidence points to a filtrable virus as the causative agent of poliomyelitis, although so far as the human subject is concerned the theory still is not definitely proved. Van Rooyen and Rhodes[5], ten years later (1948), make the following significant remark concerning this fact: "Theories of the pathogenesis of human poliomyelitis have resulted largely from experimental work on monkeys rather than on observations on the patient." *A theory is valid only if it explains all facts without exception.*

The writer[6-18] has emphasized repeatedly, as have others, that, despite the finding of a virus associated with cases of human poliomyelitis, the fundamental cause of this disease appears to be a poisonous or toxic activator and that the fundamental problem, as far as the human disease is concerned, is one of chemistry. The clues are numerous, well known, and too strong to be ignored: they have not been followed adequately. It is the purpose of this report to simplify, as much as possible, this concept of the cause of human poliomyelitis and to show that there may be an intimate relationship between virus diseases and diseases resulting from toxic causes.

RELATIONSHIP BETWEEN TOXICOLOGY AND VIROLOGY

The association of viruses with cases of poisoning is a well recognized fact. It is illustrated by the herpes simplex that follows the injection of vaccines, milk, colloidal metals, ingestion of foodstuffs, general anaesthesia, etc.[5, 19-21] and the herpes zoster that follows the intake or injection of arsenic, bismuth and sul-

fonamides, and carbon monoxide, alcohol, or phenobarbital poisoning[22-24]. Ritchen and Kantor[25] (1947) reported herpes zoster as a toxic manifestation from the administration of antimony in the treatment of schistosomiasis. Both herpes simplex and herpes zoster occur at times in association with infectious diseases which appears to indicate that toxins produced in the course of these specific diseases may be responsible. The lesions of both herpes simplex and herpes zoster, regardless of the primary cause, are histologically characterized by intranuclear inclusion bodies, and a virus can be isolated from the lesions. Fixation occurs between the sera of cases of arsenical or bismuth zoster and zoster antigen[26].

In 1900, there occurred an epidemic of arsenical poisoning in and around Manchester, England, involving several thousand beer drinkers[27-29]. For fully six months the etiology was not discovered and the patients exhibited in sequence digestive symptoms, nasal and pharyngeal catarrh, bronchitis, acute skin lesions, disturbances of sensibility, motor paralysis, pigmentation and keratoses. Reynolds[28], toward the end of this period, observing an unusually large number of cases of herpes zoster during the epidemic and recalling numerous reports of this type of eruption occurring in association with arsenical poisoning, came to the conclusion that this drug must be the source of the epidemic. Investigations revealed that the arsenic originated from Spanish pyrites that war used in the making of sulfuric acid which was employed for the preparation of sugars used in the brewing of beer. Thus, the cause of a mysterious epidemic with many protean features, viz, gastro-intestinal, respiratory, dermatological, and nervous symptoms was eventually unraveled by finding the clue in a virus disease which was a concomitant feature. There was clearly a cause and effect relationship.

In the earlier literature there appeared many reports of cases of poliomyelitis complicating or following the common infectious diseases, viz, measles, scarlet fever, influenza, smallpox, etc., which were interpreted as resulting from the effects of the toxins of the original disease on the anterior horn cells of the spinal cord. More recent work, which indicates a similar situation, is the poliomyelitis following the injection of toxic antigens, viz, pertussis vaccine and diphtheria toxoid. The writer already has discussed this form of human poliomyelitis in a previous report[18].

A clue to a relationship between virus diseases and diseases

resulting from toxic causes appears to exist in the *inclusion body*. These bodies were considered to occur only in virus diseases and to be composed of numerous virus particles or elementary bodies. However, it is now known that inclusion bodies occur not only in virus diseases but also in a variety of other diseases, including those resulting from poisons and toxins. Although transfer experiments with experimental animals have not always been possible with material containing inclusion bodies, the reason why viral material is present in some cases and not in others has not been explained.

Blackman[30] (1936) found intranuclear inclusion bodies in the kidneys and livers of children dying from the effects of acute lead poisoning and lead encephalitis. He was able to produce them experimentally in the kidneys and livers of white rats by administering lead carbonate in water mixed with the food that was fed to the animals.

Wolff and Orton[31] (1932) found intranuclear inclusion bodies similar to those found in poliomyelitis in a number of conditions, including toxemia of pregnancy, tuberculous meningitis, chronic basilar meningitis, myasthenia gravis, tetanus, acute suppurative leptomeningitis, chronic epidemic encephalitis, meningeal fibroblastoma, pernicious anemia, dissecting aneurism, chronic pulmonary tuberculosis, cerebral epidermoid, suppurative thrombophlebitis of uterus and pelvic veins, aneurism of the right anterior cerebral artery (ruptured), spongioblastoma multiforme, and protoplasmic astrocytoma.

Hembacker and O'Leary[32] (1930) showed that repetitive stimulation by electricity of the axon brings about granulation of the chromatin and its clumping about the nucleolus. The chromatin mass resembled the nuclear inclusions which have been considered pathognomic of several virus infections. Davenport et al.[33] (1931) found that nuclear inclusions occurred with great regularity in extirpated ganglia in hypertonic solutions. They attributed them to disturbed osmotic conditions in the cells. Lee[34] (1933) observed nuclear changes following the intravenous injection of various solutions. These included 50 per cent sodium chloride, distilled water and salyrgan. Intranuclear inclusion bodies were observed which simulated those described by Covell[35] (1930) in the nerve cells of acute anterior poliomyelitis.

Cox and Olitsky[36] (1934), in studies on the prevention of ex-

perimental equine encephalitis in guinea pigs by means of virus adsorbed on aluminum hydroxide, observed intranuclear inclusion bodies characteristic of encephalitis virus infections in the phagocytic mononuclear and giant cells of the induced subcutaneous nodules. When the chemical alone, free from the virus, was introduced under the skin of guinea pigs, similar inclusions were seen in the resulting foreign body reaction. Olitsky and Harford[37] (1937) were able to produce intranuclear inclusion bodies, indistinguishable from those observed in virus infections, by the injection of aluminum compounds, ferric hydroxide and carbon. Brain tissue derived from apparently healthy guinea pigs produced similar inclusion bodies when it was injected. Birch and Lucas[38] (1948) produced intranuclear inclusion bodies consistently with aluminum oxide injections. Van Rooyen and Rhodes[5] (1948) point out: "Histological changes similar to those seen in infective encephalitis may be produced by carbon monoxide poisoning, brain injury, arteriosclerosis, uremia, pregnancy toxemia, and toxic agents like alcohol and lead."

NATURE OF A VIRUS

The word "virus" was originally used only in the singular and meant a poison. Later, with the establishment of a difference between poisons and infectious agents, the word "virus" was used only in connection with the latter entities. The word was eventually applied only to those infectious agents capable of passing through filters that retarded ordinary bacteria. The relationship of poisons and viruses was not considered, but, in view of more recent developments, there appears to be a vast field yet to be explored between these two extremes.

Following the discovery of a virus in association with cases of human poliomyelitis, it was generally accepted, at least as a working hypothesis, that this virus is a small exogenous organism. This hypothesis led to attempts to establish a portal of entry, mechanism of dissemination within the body, and communicability in order to confirm this concept. However, these facts have not been conclusively established after nearly half a century of research. It is now known that the most intimate contacts—such as healthy and sick individuals in one bed, the attendance of physicians and nurses upon the sick, the use of unclean linen, clothes,

or beds, unsanitary conditions, insects and animals, post-mortem examinations of poliomyelitis victims, and other factors—have in no wise contributed to the spread of the disease. Yet, the original concept, i.e., that the poliomyelitis virus is an exogenous organism is so deep-rooted in the minds of many physicians, as well as the public, that ineffective and obsolete measures to control human poliomyelitis continue to be employed.

The conspicuous achievements of Dr. Wendell M. Stanley[39], a chemist, show clearly how unlimited research can bring about remarkable scientific advances, whereas the general acceptance of and adherence to a theory can cause retardation. Stanley reported, in 1935, that the tobacco mosaic virus, which had been considered to be a small organism, is a crystalline protein of high molecular weight. Rivers[40] (1941), a bacteriologist, described Stanley's work as follows: "While a few investigators had stated that a chemical agent instead of a microorganism is responsible for tobacco mosaic, Stanley was the first to bring a respectable amount of proof that infectious diseases are not of necessity caused only by microorganisms. Stanley's findings, which have been confirmed, are extremely important because they have induced a number of investigators in the field of infectious diseases to forsake old ruts and seek new roads to adventure. As much as bacteriologists hate to admit it, Stanley's proof that tobacco mosaic virus is a chemical agent instead of a microorganism is certainly very impressive. Moreover, every one admits that the agent of tobacco mosaic is transmissible indefinitely in series from plant to plant, a fact beyond dispute, indicating abundant multiplication or reproduction of the virus. Inasmuch as reproducton is usually considered an attribute of life, great confusion and consternation has been caused. In fact, the results of Stanley's work had the effect of demolishing bombshells on the fortress which Koch and his followers so carefully built to protect the idea that all infectious maladies are caused by living organisms or their toxins. In addition, his findings exasperate biologists who hold that multiplication or reproduction is an attribute only of life."

It was thought, long before Stanley's discovery was reported, that viruses are the product of tissue cells which have suffered the action of some deleterious influence, this new product in turn being capable of engendering the same change in other cells. Stan-

ley[41] emphasized in 1939, that the all important and fundamental problem of virus activity is one of chemical structure, and that it is a straightforward problem of structural chemistry.

Rivers[42] (1932) had stated seven years earlier, before Stanley's amazing discovery: "The confused state of our knowledge of the viruses at the present time makes it exceedingly difficult to define the nature of these active agents. The easiest way out of the dilemma, however, would be the acceptance of the presumptive evidence that viruses are minute microorganisms. Yet, the easiest way and the one that best fits the experience of the day might not be the right one." Subsequent developments showed that this presumptive evidence was untenable.

Stanley's work showed that the tobacco mosaic virus could not only be crystallized but the virus activity is a specific property of the nucleoprotein of which it is composed. Many strains of the mosaic virus have been isolated and these consist of closely related nucleoproteins. All viruses thus far purified have been found to contain or to consist of nucleoprotein and this fact has led some workers to consider it possible that viruses may be derived from genes or nuclear material. Since Stanley's discovery, many workers believe that the particles of certain viruses are protein macromolecules that may multiply in their hosts by a process of autocatalysis.

The concept that is now generally accepted to explain herpes manifestations is that sometime during the life of an individual the herpes viruses enter the human body and remain latent until some factor or factors activate them. The evidence to support this view, however, is still necessarily indirect and it is largely derived from seriological studies. On the other hand, there is much to support the concept presented by Doerr[43], a Swiss bacteriologist, in 1938. He considered the herpes virus to be endogenous in origin produced within the cells by certain physiological stimuli. Once the agent has been produced it will act on the cells of susceptible animals of different species as a true virus exciting in them, when appropriately injected, the production of an antiserum specifically antagonizing the virus of herpes infection. According to this view, the virus is primarily a derivative of the physiologically modified cells. Jenner[44] (1804) speaks about the herpetic fluid as one of the morbid poisons which the body is capable of generating and

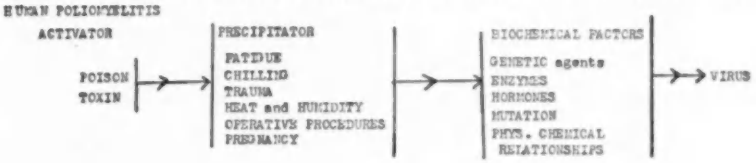
when generated it may be perpetuated by contact. In a letter dated October 25, 1804, he says: "Children who feed on trash at this season of the year are apt to get distended bellies and on them it often appears about the lips."

Reports of experimental work have appeared, leading to claims that normal cells have been induced to manufacture certain viruses. Carrel[45] (1926) was able to produce tumors resembling Rous' sarcoma and transmissible by cell-free filtrates with indol, arsenic, or tar in chicken embryo. Carrel's observations have been confirmed by other workers. Fischer[46] (1926), by treating cultures

CHART 1

THE MECHANISM OF PRODUCTION OF HUMAN POLIOMYELITIS VERSUS EXPERIMENTAL ANIMAL POLIOMYELITIS

HUMAN POLIOMYELITIS



EXPERIMENTAL ANIMAL POLIOMYELITIS

VIRUS → STRAINS → TRANSFER EXPERIMENT → PURIFICATION → CULTURE → PREVENTIVE AGENTS

of normal cells with arsenic obtained on one occasion a filtrable virus capable of causing tumors. Copisarow[47] (1939) says: "The predominance of infection over spontaneity cannot remain indefinitely a stereotyped assumption and tends to swing pendulum-like (at least in the domain of viruses) back to synthetic inception, with an intermediate position as an ultimate restpoint."

There is much evidence to indicate that the poliomyelitis virus is synthesized or activated within the human body instead of entering it as commonly assumed. Each poliomyelitis victim evidently develops, as a result of an exogenous factor, an autogenous infectious agent which is not transmissible under natural conditions to other human beings. However, when this infectious agent is concentrated it can be inoculated into experimental animals to produce experimental animal poliomyelitis. Thus, there is a chain of chemical reactions from the time that a human is exposed to a poison or toxin until a virus is synthesized or activated. The

experimental disease, on the other hand, using the product (virus) resulting from the poison activator, is purely a virus infection. The failure to demonstrate in the prevention and treatment of natural human poliomyelitis the efficacy of blood serum, the vaccines of Kolmer and Brodie, zinc sulfate nasal sprays, the sulfa drug, darvisul (phenosulfazole), and gamma globulin, although their value was proven conclusively in experimental animal poliomyelitis, appears to indicate clearly an entirely different mechanism in the natural human disease in contrast to the artificial disease in experimental animals. These facts are represented in Chart 1.

POISON AND TOXIC ACTIVATING FACTORS

There are potential poisonous and toxic activating factors present in food and water during epidemics of poliomyelitis that can account for much that has been thus far unexplainable by the exogenous virus theory. Fruits, vegetables, milk and water have been mentioned many times in relation to the cause of human poliomyelitis by medical writers, and they are suspected frequently by the laity. Specific instances of an etiological relationship between fruits, vegetables, milk and water and human poliomyelitis have been reported infrequently, however, because of the fact that epidemiological studies are limited almost exclusively to possible person to person contacts and carriers of an exogenous virus. Sabin[48] (1951), although insisting on the exogenous virus etiology of human poliomyelitis, implicates food and drink as important factors in the cause of the disease. However, little attention has been given to the kind or the source of the food or drink used by poliomyelitis patients prior to or during epidemics of this disease, even in the search for an exogenous virus.

Dr. H. C. Emerson[49] (1907), Massachusetts State Inspector of Health, District 14, investigating an epidemic of poliomyelitis in that state, made careful inquiries regarding the food that had been eaten by the patients. He found in six cases that fruit and berries had been a large item of the diet. In the case of two infants, bananas and berries had been given in the diet in addition to breast milk. In three cases of poliomyelitis, the illness was attributed to the eating of large amounts of blackberries and blueberries. In one case the illness was credited to eating heartily of English mulberries. In 39 instances it was stated that food supplies were

bought from fruit and vegetable peddlers in their localities. Draper[50] (1935) recorded a series of cases of poliomyelitis which he considered to have originated from the fruit purchased from a Greek fruit dealer. Barber[51] (1939) reported four cases of poliomyelitis that developed simultaneously on the same day from the eating of strawberries in a single house of an English boarding school. Barber points out that the simultaneous onset of these cases resembled food poisoning. Goldstein et al.[52] (1946) reported an epidemic of polioencephalitis at a naval training school among cadets. The epidemic was explosive in character and involved over 100 persons. Epidemiological evidence suggested that some food served in the mess hall was the cause of the disease.

Gebhardt and McKay[53] (1946) investigated an epidemic of poliomyelitis in Utah in 1946. The only food in common in all cases in the survey were fresh fruits and vegetables. The writers point out that the peach, pear, apple and tomato production peaks closely parallel peaks of epidemics of poliomyelitis and that when several cases of this disease occur in a family at about the same time, it can be explained by a common food source. The authors state that their data appears to fit into the jigsaw puzzle of epidemic poliomyletitis.

Lepine et al.[54] (1952) point out that during the occupation of France by the Germans, adults, and even young children, ate large amounts of salads, as no other food was easily available, and the incidence of poliomyelitis was about twice as great as usual. Raw milk and even butter may be the cause of some cases of poliomyelitis, they state. Investigations in France, they point out, favor the digestive origin of poliomyelitis and the cases in the region of Paris are best explained by the ingestion of foods, such as green vegetation.

Wickman[55] (1913) first suggested milk in connection with an outbreak of poliomyelitis. In the parish of Ukla a case appeared on October 6, 1905. The father of the patient had a dairy farm. Another son and four other children of the neighborhood were stricken with the disease on October 20. Altogether six families were attacked, and ten cases occurred; all were supplied with milk by the father of the initial case.

Dingman[56] (1916) reported a small outbreak of poliomyelitis in an institution which resulted from the use of milk from a common

source. The cases occurred in three different and widely separated Jewish boarding homes at Spring Valley, N.Y. The house mothers of these homes were quite positive, even before the diagnosis of poliomyelitis was made, that the milk was the cause. The eight cases of the disease were the only ones which had developed in or about Spring Valley up to that time and for some weeks after.

Knapp et al.[57] (1926) reported an outbreak in December of ten cases of poliomyelitis in Cortland, N.Y. which was traced to the milk supplied by one dealer. The epidemic started abruptly and ceased with the discontinuance of the milk.

Aycock[58] (1927) reported a poliomyelitis epidemic of unusual severity caused by milk in Broadstairs, England, in October 1926. The outbreak started and subsided suddenly, 62 cases being reported between October 14 and 29; 31 of these appeared on October 14 and the five days following. Multiple cases occurred in private boarding schools having little communication with the town or with each other. Four visitors, who had left Broadstairs just prior to the epidemic, developed the disease at the height of the epidemic in Broadstairs in widely separated places practically simultaneously with each other and with the majority of the cases in Broadstairs. Investigation disclosed that practically all the cases of poliomyelitis in this epidemic were supplied with milk from the same dealer and from a single farm.

H. Davide[59] (1928) reported a small outbreak of poliomyelitis in North Sweden caused by milk.

Rosenow[60] (1932) described an outbreak of poliomyelitis traceable to milk and cream in a midwestern college. Most of the students roomed in the six dormitories on the campus; a few lived in town near the campus. All ate their meals in large dining rooms in three of the dormitories. The epidemic occurred abruptly in the late autumn. There were eight frank and several abortive cases which developed within a period of six days. The epidemic disappeared as suddenly as it appeared after the discontinuation of the milk and cream. The milk and cream supplied by the college dairy was served at only one of the dining rooms for women from which two cases of poliomyelitis developed and at the dining room for men from which six cases developed. Numerous students eating in these particular dining rooms had symptoms that com-

monly occur during the early stages of poliomyelitis, chiefly gastrointestinal and nervous system manifestations.

Rosenow et al.[61] (1933) described an epidemic of poliomyelitis at White Bear Lake, Minnesota, which was caused by milk. The incidence of multiple cases in family groups was unusually high. The epidemic occurred late in the autumn in several explosive outbreaks during and immediately after spells of warm weather.

Kling[62] (1928) supported the theory that poliomyelitis could be spread by means of water supplies. He observed that the disease first broke out near the water supply in the hills, cases occurring successively as the stream descended. Gard[63] (1938) stressed the importance of increased rainfall and mentioned a laborer who was alleged to have contracted poliomyelitis a few days after drinking water from a ditch. Paul and Trask[64] (1941) found, during an epidemic of poliomyelitis, that the distribution of cases followed a water course. Casey[65] (1945) incriminated the water supplies for sporadic cases occurring in a small parish in Alabama, in one village out of numerous areas involved. They point out that a connection between water and epidemic poliomyelitis cannot be disregarded. McFarland et al.[66] (1946) described an epidemic of poliomyelitis, explosive in character, which began in Mauritius, in February, and terminated in April. Three cyclones hit the island, one before and two during the epidemic period, and rainfall was less than average. Flour and vegetables were the staple diet because of the war. There was an increasing prevalence of intestinal complaints when the poliomyelitis epidemic began. In fact, there was an explosive rise in them in the second half of February. In one village, Triolot, an explosive epidemic of poliomyelitis appeared to have been caused by the eating of ices.

In order to understand the relationship of fruits, vegetables, milk and water to poliomyelitis, we must realize that under certain conditions they may contain poisons or toxins which can constitute activating factors. During droughts, for example, the incidence of poliomyelitis is usually very much increased. It is this lack of water from rainfall, which is necessary for the proper growth and maturity of vegetation, that causes the development of toxic products in fruits and vegetables. They are to be found in greater concentration in unripened than in ripened fruits and vegetables

and under conditions of drought, fertilization by chemicals and other factors. Plants in an unhealthy condition, whether this is brought about by malnutrition, improper transpiration, insect attack or other causes, usually contain more toxic products than healthy ones. Toxic products, likewise, are to be found in spoiled foods during the warmer months.

Cows, deprived of their normal forage during droughts, are forced to overgraze and will at times eat deep-rooted poisonous weeds and other toxic plants, thus transmitting the poisonous principle into the milk and milk products. Milk may contain not only the toxins from weeds and plants that are transmitted by the cow but toxins may develop also in the milk after it is procured as a result of bacterial activity and chemical changes. Another factor to be considered during droughts and epidemics of poliomyelitis is that many wells dry up; others, that are productive, may contain toxic organic matter. Larger bodies of water supply are also affected by drought and may also contain toxic organic matter. The insect menace to crops, etc. during the warm months of the year is controlled by poisonous insecticides which is also a factor of importance to be taken into consideration during epidemics of poliomyelitis. In agriculture alone 232 million pounds of insecticides were used in the United States in 1951, and 252 million pounds in 1952[67]. The increase in poliomyelitis during recent years runs parallel with the increasing use of insecticides which may be more than a coincidence. Lille et al.[68, 69] showed that one insecticide, DDT, may produce degeneration of the anterior horn cells of the spinal cord of animals.

Although epidemics of poliomyelitis occur notably during droughts, some have appeared when rainfall is excessive. In either case, the normal growth of vegetation is interfered with and toxic products may develop in fruits and vegetables. Excessive amounts of water in the soil interfere with biological processes and limit the amount of oxygen. It is not to be overlooked that a greatly diminished amount of snow during the winter months really constitutes a drought and under such conditions the proper growth of vegetation may subsequently be adversely affected. This lack of water cannot always be compensated for by large amounts of rain later in the year. Further, much decayed toxic organic matter can be carried into the soil and subsequently contaminate wells when the

rainfall is excessive; surface water containing toxic material may be carried into larger bodies of water under such conditions.

The seasonal incidence of epidemics of poliomyelitis has always been one of the puzzling features of the disease. Epidemics are reported chiefly in the temperate zones. Toomey and August[70] (1933) collected data that indicates that the incidence of poliomyelitis is highest in those countries in the temperate zones that raise the same types of agricultural products. In the Northern hemisphere, poliomyelitis occurs mainly in the summer and autumn whereas in the Southern hemisphere, it occurs in the first four months of the year. These facts correspond with the growth season and harvest of perishable fruits and vegetables in these different parts of the world. In the United States, poliomyelitis appears about a month earlier in the Southern states than in the northern. The incidence of poliomyelitis in this country likewise corresponds with the growth and harvest seasons. The cessation of epidemics of poliomyelitis with the onset of cold weather is explained by the cessation of growth and harvest of vegetation. It is common knowledge, even among the laity, that with the onset of cold weather poliomyelitis epidemics subside and finally disappear.

(*To be concluded in May issue*)

CRYOTHERAPY IN ACNE. (Semaine Des Hôpitaux De Paris. 29: 3373, Oct. 30, 1953). Cryotherapy for the treatment of acne as first described by Giraudeau in 1929 consists of massaging the affected portion of the body with a mixture of carbon dioxide snow, acetone, and sulfur. The authors feel that this method should not be discarded, since it has proved its worth in the treatment of acne that is not amenable to iodized, sulfurized, or salicylized and resorcinized lotions and can be used without interrupting the patient's activity. It is particularly successful in curing papulopustular acne of young persons with fatty skin. It can be used in conjunction with ultraviolet irradiation and trichloroacetic acid to obtain a rather forceful simple desquamation or a true exfoliation that generally permits the patient to continue his normal routine.

—*J.A.M.A.*